ASEPSIS & ANTISEPSIS
IN
ABDOMINAL SURGERY
AND
GYNÆCOLOGY

H. MACNAUGHTON-JONES

BAILLIÈRE, TINDALL & COX.

Thos. O. Byers
Greenmount,
Belfast.

ASEPSIS AND ANTISEPSIS

IN ABDOMINAL SURGERY

AND

GYNÆCOLOGY.

FOR GUIDANCE IN MEDICAL HOMES AND PRIVATE PRACTICE.

BY

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PREFACE.

THIS short *brochure* on modern aseptic and antiseptic methods is the outcome of suggestions made to me by friends who have visited my private installation. I have also been induced to publish it in consequence of the many inquiries I have had from surgeons on several matters on which it deals.

I have already written on the same subject, in connection with visits paid by me to the clinics of Berlin and Paris, in the *British Gynæcological Journal* of 1897 and 1898.

The principal matters treated of are: Installation in a private home; the various aseptic appliances required; the methods of sterilizing all dressings, sponges, gut, and silk; the different antiseptic solutions and dressings; the preparation of the surgeon, assistants, and nurses before operation; the rules to be observed by the nurses; the preparation of the patient and the conduct and toilette of an operation.

I also give a brief summary of the practice of some of my foreign *confrères*, as witnessed by me in their clinics.

I have to thank Dr. Arthur Giles for his assistance in arranging the matter of the book. He has also given me the result of his personal impressions of the aseptic methods at Dr. Howard Kelly's clinics.

To Dr. Doyen I am indebted for the plates illustrative of his ingenious operating-table, placed in various positions. Messrs. Arnold and Son have, at my request, made several special engravings of appliances. I give the names and addresses of the Berlin and Paris makers of the various aseptic and antiseptic appliances. But many of these can now be obtained through Messrs. Arnold, of West Smithfield.

H. MACNAUGHTON-JONES.

141, HARLEY STREET, W.

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antiseptics. Doyen's operation-table. Installations at the Rue d'Iena and at Rheims. Preparation of artificial serum. A. Martin's Frauen Klinik, Elsasser Strasse, Berlin. Landau's Frauen Klinik, Dorotheen Strasse, Berlin. Howard Kelly's clinic, John Hopkins' Hospital, Baltimore 49

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INTRODUCTION.

THE question is often asked, "Are the aseptic and antiseptic methods resorted to on the Continent and in America more perfect and complete than those used by British surgeons?" Last year I referred, in the *British Gynæcological Journal*, to the perfection of the German methods, and the manner in which aseptic precautions are carried out in some of the leading *Frauenkliniks* in Berlin, such as the University *Frauenklinik*, under Professor Olshausen, and the clinics of Professors Martin and Landau. This year I described in the same journal the steps taken by our Paris *confrères* for securing complete antisepsis and asepsis.

With regard to hospital methods, there can be no possible excuse for even the slightest defect in any of the details. Here economy has seldom to be considered. In his theatre, appliances and assistance, both before, during, and after operations, the surgeon is amply provided for; and it is simply unpardonable if any accident occurs which can by possibility be traced to a flaw in the methods.

It is, therefore, rather with a view to insisting on the need for caution *outside* the hospital operating theatre and ward, that I write this short summary of the methods that I myself pursue, and that can be carried out in any medical home or private house. I have not the least doubt that there is still, even with all our knowledge of the vital

importance of asepsis, a great deal of inexcusable negligence in the manner in which this first essential of the modern surgical art is achieved; in short, there is much that is casual in the manner in which preparations are made, and the regard that is placed on such precautions. Possibly this may arise from the fact that, though in a misty sort of way the need for them is recognized, it has only been of recent years that the profession generally has begun to realize their vital necessity. This observation applies to surgeon and nurse alike. Looseness in the education of both has generated a corresponding laxity in their ideas as to how complete asepsis is to be maintained; and we are now in that transition stage between the older practices of simple antisepsis, often indifferently carried out, and the far more scientific and correspondingly difficult aseptic procedures of the present day. Those educated under the old plan find it difficult to adapt their surgery to the demands of the latter, nor in some respects can we blame them, when we yet find responsible teachers and operators who speak slightingly of the unnecessary refinement of care with which the Continental and American surgeons carry out aseptic surgery.

Convinced of the extreme importance of exact attention to the minute details as well as to the general principles of asepsis and antisepsis, my object is to lay down precise rules, based on my own experience and that of others, to be observed in the arrangements of the operating-room, the preparation of the patient, the operator, and his assistants, and the care of instruments, dressings, and other appliances, dealing with the matter more especially from the point of view of the abdominal surgeon and gynæcologist. And in order to make these observations as practical and useful as possible, I shall enter into the

question of the installation of a private operating-room with everything that is essential to the purpose.

I am in perfect agreement with the views of Doyen that "when we lose a patient who has been operated upon, the most common cause of death is infection within the operative tract, an infection facilitated by the reduction of the vital resistance brought about in enfeebled and cachectic subjects, particularly among the cancerous. Many surgeons (we cannot too strongly insist upon this point) commit the grave error of believing themselves *à priori* aseptic, and account for their failures by causes other than the direct infection from the wound. This pretension' to infallibility in antisepsis is as ridiculous as it is dangerous. Even in cases where complications occur at a distance from the field of operation, such as bronchitis, pneumonia, phlebitis, etc., it is very rarely found that they arise from any cause save as the direct consequence of interference." "If the patient should succumb," says Doyen, "carefully study the probable causes of death, and question your memory on the minutest details," and he goes on to remark that to an interference, out of all proportion to the vital resistance of the patient, which has been too prolonged, or to infection alone, we may often ascribe the fatal issue, and still more frequently to both causes combined. This conclusion he says he has come to as the result of many years of experience acquired in the service of various hospitals in which bacteriological observations of the most searching kind were conducted as to the cause of death after operations.

Some may consider that certain minute details are carried to extremes on the Continent and in America. I do not think so. There may be limits to our possibilities in private "homes" and houses, but there are no

such limiting conditions in our hospitals. Far better this attention to the minutest details, than that the entire system should be rendered ridiculous by glaring oversights on the part of operator, assistants, and nurses, in the handling and transferring of instruments, ligatures, and sutures, in the casual exposure of these to sources of infection before and during operative manipulations, and by other faults of omission and commission. Such errors have justly brought severe criticism on our British antiseptic methods—criticism which cannot be answered. This should not be so in the birth-place of antiseptic surgery. Call it by whatever name we may, the surgical world, at the close of this nineteenth century, with such few exceptions that they seem only to prove the rule, has accepted the teachings of Lister, and the universality of that acceptance, as well as the results of the adoption of those teachings, are the unanswerable testimonies to their truth. No theory in the history of medicine has been subjected to more universal, more crucial tests, by observation or experiment, than that of the germ theory in wounds, in relation to septic changes in these. The practical result has been the universal adoption of antiseptic surgery, and no department of the surgical art has benefited more by the use of antiseptic and aseptic methods than that of gynæcology.

CHAPTER I.

ASEPSIS AND ANTISEPSIS.

THE differentiation of the terms "antisepsis" and "asepsis" is hardly understood. The need for separating into two distinct categories septic from aseptic operations is not fully appreciated or realized, either by surgeons or nurses. Antisepsis before, and asepsis during, an operation, should be secured by methodical and systematic precautions never departed from. This is the invariable rule.

It is no infrequent occurrence for a nurse to constantly assure one that she is thoroughly versed in both antiseptic and aseptic methods, and yet to find that when she is subjected to the practical test of attendance upon an operation and attention to a case, she is deficient in many of the first principles of her work. There can be only one standard for the hospital surgeon on the one hand, and the practitioner or surgeon who operates in the private "home" or house on the other, and though the latter may not be able to achieve that degree of perfection which should always be at the command of the former, still he must strive, so far as it is within his means and possibilities, to do so. Fortunately, in consequence of all the recently constructed appliances which render it easy for the surgeon to carry with him, without danger of contamination from any outside source, all his sterilized instruments,

dressings, compresses, and sponges, as well as his various ligatures—and not only these, but also the sterilized nail-brushes, antiseptic soap, and the overalls for himself and assistants—the operator can reduce his risk of failure in detail to a minimum. And there is no longer any plea that can be advanced, either on the part of those who have to prepare for an operation or of the operator, that the person whose life he is taking in his hands should be subjected to an unnecessary risk, for the incurring of which there can be but two explanations—ignorance or negligence.

It may not, then, be without advantage to emphasize what true antisepsis and asepsis really mean. By *asepsis* I understand an absence of all septic organisms. This condition is secured by certain methods which have relation to the disinfection of the hands of the operator, assistants, and nurses; to the purification of the area of operation before, during, and after surgical intervention; and to the cleansing of the instruments, sutures, sponges, dressings, and other appliances employed. When no pathogenic organisms are present in any of these situations, the condition is one of Asepsis.

By *antisepsis* I understand any or all of the methods by which such absence of septic germs is obtained. These methods will therefore include disinfection by hot air, steam, boiling water, and the use of the various chemical germicides that destroy or render inactive the pathogenic organisms. Terrier well classifies the indications that must be fulfilled in order to arrive at a perfect aseptic method: (1) Antisepsis of the part to be operated upon; (2) antisepsis of the hands of the operator and his assistants; (3) asepsis of all the instruments or objects which, during an operation, may come in contact with the wound; (4)

subsequent effective aseptic protection of the wound during the healing process.

For many years a condition of perfect asepsis in operations has been the ideal of surgeons. It is hardly too much to say that even at the present day the best results obtained are only an approximation in the direction of that ideal. But of this we may rest assured, that the nearer we come to its realization the nearer, also, we shall attain to the elimination of all preventable morbidity and mortality after operations.

A fundamental difficulty in the securing of perfect asepsis lies in the fact that normally various organisms, some of them pathogenic, are constantly present in the skin, in the digestive canal, and in the female genital passages up to the osuteri internum; of those inhabiting the skin, at least one organism, the *Staphylococcus pyogenes albus* (*Staphylococcus epidermis albus*, Welch) lies deeply in the epidermis, or hair follicles, beyond the reach of any antiseptics. On the other hand, it is to be remembered that infection depends not only on the presence of a germ, but also on the weakening of the resistance of the tissues; consequently with favourable circumstances an organism, otherwise pathogenic, may be in fact inert, so that, as Howard Kelly truly says, "a fresh wound containing these organisms may, from a surgical standpoint, be considered as aseptic when the process of healing is in no way interfered with."

These considerations bear out the statement made above, that the best results obtained are only an approximation in the direction of an ideal asepsis; and the rule of practice that is binding on all surgeons is thus laid down by Howard Kelly: "As it is not possible to differentiate beforehand the specific character of the various germs

that are present, especially as to their pyogenic properties and virulence, modern surgery *first* proceeds upon the assumption that the skin of the patient, of the surgeon, and of the assistants, the instruments, the dressings, etc., are in an infected state until rendered aseptic by the use of antiseptic measures; and *secondly*, it endeavours to maintain the aseptic condition thus established throughout and after an operation."

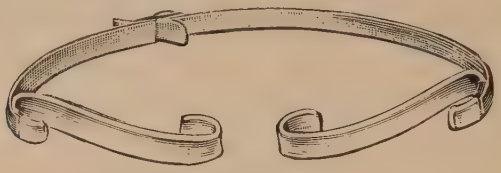
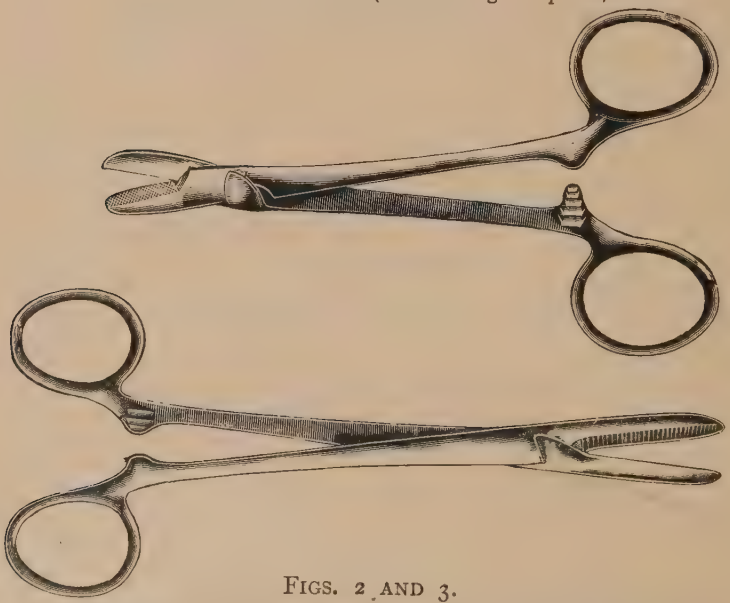


FIG. 1.

Glass retractors of Author (self-retaining if required).



FIGS. 2 AND 3.

Aseptic hæmostasis forceps and needle-holder of Doyen (detachable blades for cleansing). (All forceps, scissors, clamp-forceps, tenacula, etc., should be made on this principle.)

CHAPTER II.

OPERATING-ROOM IN PRIVATE HOME OR HOUSE.

THE OPERATING-ROOM.—My object being, as I have said, to dwell on the necessity that exists *outside* a public hospital for the adoption of as complete asepsis and antisepsis as may be secured, I desire to show how a small private operating-room can be constructed at a comparatively small cost, and, though not as perfect as the theatre of a hospital, can still, so far as the materials for asepsis and antisepsis are concerned, be brought as near to perfection as can be hoped for with the means at our disposal.

The room selected must be well lighted and well ventilated. The best window is a sloping skylight facing the north. The floor may be composed of square encaustic tiles, or of a well-laid parquet flooring thoroughly saturated with wax, and highly polished. A more economical plan is to have the floor cemented; or as a still cheaper expedient, a highly glazed linoleum may be used. In any case, the floor should be well washed daily, and scrubbed once or twice a week. On the walls and ceiling there should be no ornamentation or projections; and it is an advantage to have all re-entering angles rounded off. The material of the walls should be a hard smooth cement, coated with some kind of enamel. For this purpose a beautiful new "lacquered paint" is made by Messrs. Flicoteaux,

Paris,[1] which gives a porcelain surface, is capable of being scratched without detriment, and is thoroughly aseptic. All walls and shelves should be prepared with this.

For artificial illumination, electric and incandescent lights answer best. One good light should be placed just above the operating-table, and near it should be fixed a bracket, to which can be attached a portable electric lamp. For vaginal operations, two lights may be fixed, placed one on each side, behind and a little above where the operator sits.

The first important item in the furnishing is the lavatory equipment. The cleanest arrangement is a porcelain hopper or sink with detachable basins made of plated copper or solid nickel, for these can be sterilized; and by this means there is no possibility of coating with grease or accumulation of blood and other organic discharges. The traps in the pipes must be seen to frequently. Hot and cold water should be laid on, and if the cost be not a consideration, the taps can be turned on, and the waste plug lifted, by pedal arrangement. In addition, one or two portable lavabos may be used for rinsing and disinfecting the hands during an operation.

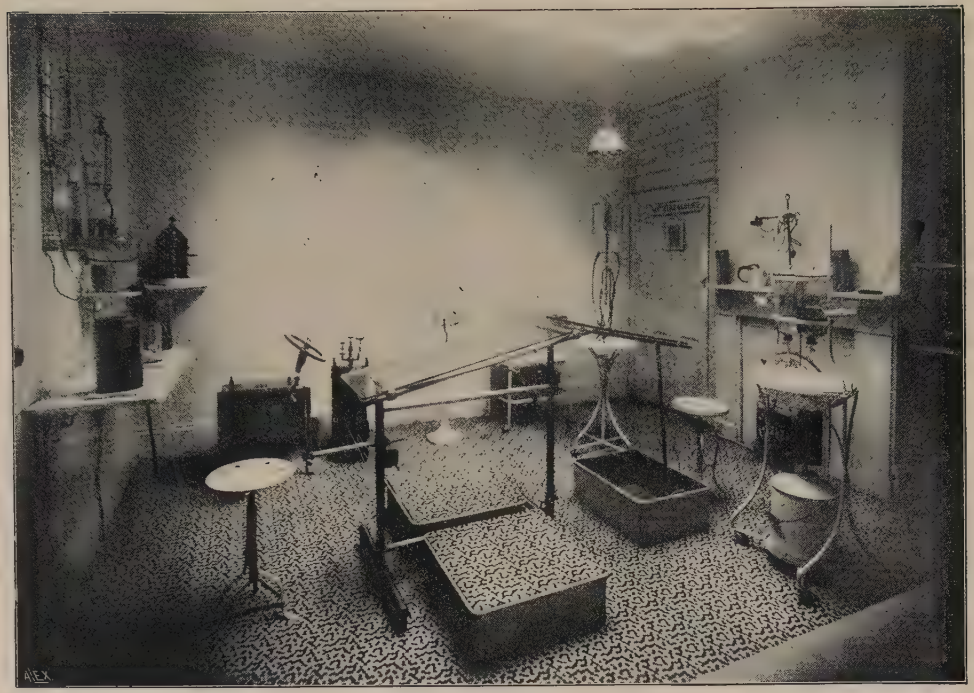
Plenty of sterilized water should always be available. Without special apparatus this can be obtained by boiling water for half an hour and allowing it to stand in covered vessels for a longer or shorter time according to the temperature required. Or if large quantities are likely to be used, a special apparatus may be employed, such as a copper reservoir lined with a steam coil connected with a boiler.

PRIVATE INSTALLATION.[2]—1. I may here describe

[1] 83, Rue de Bac, Paris.

[2] If any are desirous of seeing the other plans for the installation of perfect operating-rooms in private institutions, they will find all they

PLATE I.



AUTHOR'S INSTALLATION IN PRIVATE HOME. [*To face p.* 10.

my own installation at the "home" in which I operate. The room was thoroughly prepared for the porcelain paint to which I have referred, and with which it and the doors leading to it were entirely covered. All the shelves have the same coating. The room is lighted from the top by a glass roof, a window of which can, if necessary, be opened. Two small side windows also open into the room, and are useful for purposes of ventilation. The cupboard off the room is used for the surgeon's clothes, overalls, jackets, aprons, small blankets for the patient, and various bandages.

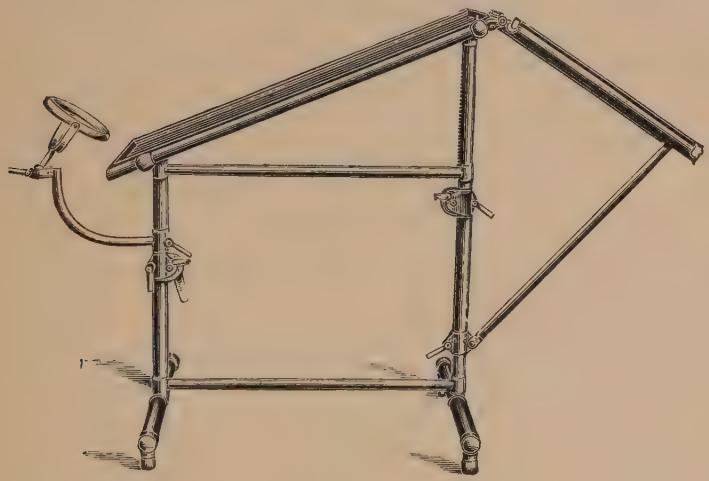


FIG. 4.
Greig Smith's glass and nickel table.

A Greig Smith's glass and nickel operating-table is the one I at present use, but it has many drawbacks for gynæcological purposes, as, for example, the incompleteness of its Trendelenberg position, and its inadaptability for

require in Dr. Doyen's recently published "Technique Chirurgicale," in which there is a complete description of the operating-rooms and their annexes of his cliniques at Rheims and Paris. (See also the drawings of various installations in Messrs. Flicoteaux's catalogue.)

vaginal hysterectomy without the use of assistants. In other respects it is all that can be desired.

[Messrs. Ferris, Bristol, are at present carrying out some suggestions of mine to provide the table at B with thigh-rests for use in vaginal hysterectomy.[1]]

Directly over the table is suspended an electric lamp with reflector, capable of throwing a 200-candle light on to the patient. This is readily raised or lowered by pulley action.

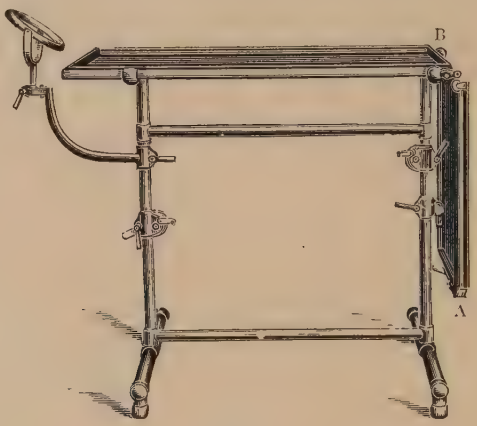


FIG. 5.
Greig Smith's table. The portion BA can be detached for vaginal hysterectomy.

The room is otherwise lighted by electricity. The room contains the vapour and dry sterilizers, a boiler, which is used for the supply of hot water, which has been previously filtered through the Chamberland-Pasteur filter. In it are also the movable *lavabos*, which can be readily rolled from place to place. No. 1 contains sterilized water for douching, and the litre-marked funnel jar for the use of sterilized serum, should such be required in emergency during or immediately after operation. This serum is made by

[1] Vide page 48.

adding 7 parts of chloride of sodium to the 1000, and the needle used is shown in the drawing. This is introduced into the subcutaneous tissue under the mammary gland, and about a litre of the fluid is allowed to flow subcutaneously in cases of threatened collapse from hæmorrhage or shock.

FIG. 6.
Chamberland-Pasteur filter, as used by Author.

No. 2 holds the trays for the instruments used in operating, and is generally large enough to accommodate the glass boxes containing the various sutures and ligatures. The second assistant, standing opposite the operator, has this stand at his side. He hands all the instruments as

they are required, as well as the ligatures, cut straight from the reels, and he threads the needles. He is thus

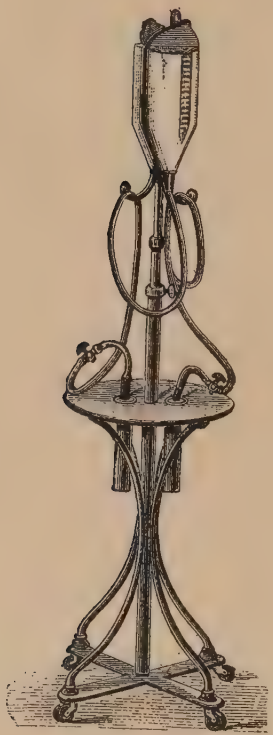


FIG. 7.
Lavabo No. 1, for sterilized serum and douche (Flicoteaux).

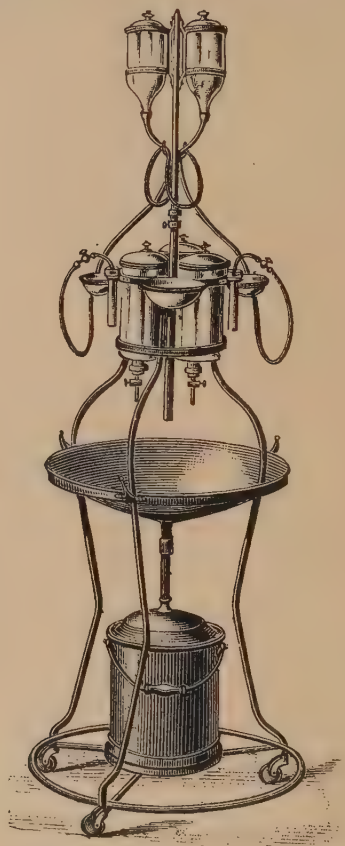


FIG. 8.
Rolling lavabo No. 2 (Flicoteaux).

FIG. 9.
Needle for artificial serum.

placed a little behind and to the side of the principal

assistant, who is directly opposite the operator. No. 3 *lavabo* is placed a little behind and to the side of the operator. The jars contain sterilized water, and it is useful for cleansing the hands during the operation. In it also the hands may be finally rinsed with running sterilized water, and the last washing given by the operator and assistant with the mercuric and alcohol solution.

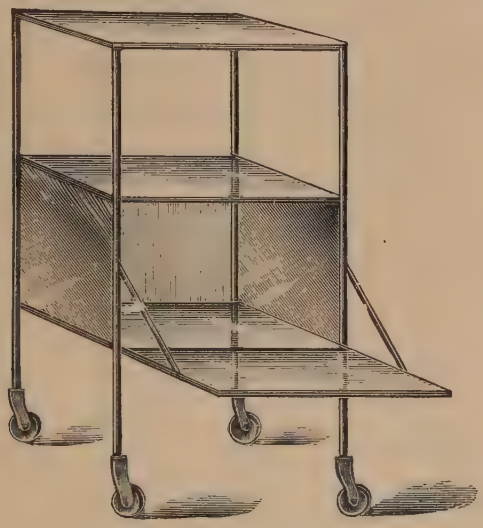


FIG. 10.
Movable stand No. 3, for instruments.

The floor of this room has to be of thick oil-cloth, as shown in the plate. This is scrubbed and washed constantly with sapolio and terebene soap. A formalin lamp, the "*Alformant*," is burnt in the room for several hours the evening before operation, and the same means is used to disinfect the closet in which the clothes are kept.[1]

[1] This lamp, with the tablets for burning in it, can be had of the Formalin Hygienic Company. For air-sterilization, 1 tablet in 1000 cubic feet; for disinfection, 10 tablets in 1000 cubic feet. Vide page 44.

Tents, and how kept.—Tents are kept in a solution of iodoform in ether, as suggested by Lefour, one drachm to the ounce, to which cocaine, in the proportion of 10 per cent., may be added.

OPERATIONS PERFORMED IN A PRIVATE HOUSE.—As regards operations performed in a private house, from what I have said I think it is manifest that with the facilities we now possess of carrying about with us in a properly constructed bag everything perfectly sterilized that can by possibility be required for an operation, if we have an intelligent assistant, conversant with the aseptic methods, we can fulfil most of the conditions that they demand of us. Clearing a room of all superfluous furniture and draperies, as well as carpets, or other source of infection, we can in a few hours have all the woodwork thoroughly scrubbed and the room disinfected. The new Alformant lamp of the Formalin Company enables us to do this thoroughly, without injury to any surrounding materials, within a period of twelve hours (Fig. 26).

Perhaps the most dangerous element in an operating-room is the uneducated or careless nurse. We are more likely to have to face this risk in the private house than elsewhere. Infection from hands, clothes, incautious handling of the patient or of soiled clothing, infectious wounds of the fingers, the presence of a cold in the head necessitating the use of handkerchiefs, are all loopholes for the admission of contamination. It is always better to make the most careful selection of the nurse or nurses who directly assist, and never to permit any nurse who prepares the patient, or places her on the table, to assist in this operation, unless there has been the most rigorous subsequent disinfection secured before any instruments or appliances are handled.

In any "home" or private house, the operating-room should be as far as possible removed from a lavatory or housemaid's closet, and the most careful disinfection of these should be secured if they are near the room in which the patient sleeps after operation.

Necessaries in the Room.—Everything needful for an operation should be in the room before it commences, and there should be no necessity for any one to leave the apartment while it is proceeding. In any private house there ought to be in readiness for the surgeon a few small buckets or pails, sufficient basins, the disinfectant solutions, bottles of perchloride of mercury and absolute alcohol, arrangements for supply of boiled and hot water, a supply of towels, small blankets, a hypodermic needle, with tablets of strychnine, some flannel bandages, irrigation-douche with tube and nozzle, two rubber sheets, a suitable table which has been well scrubbed with disinfectant, small tables for anæsthetist's instruments and for the separate basins for the rinsing of the operator's and assistants' hands, restoratives, kept together and apart, for use in emergency.

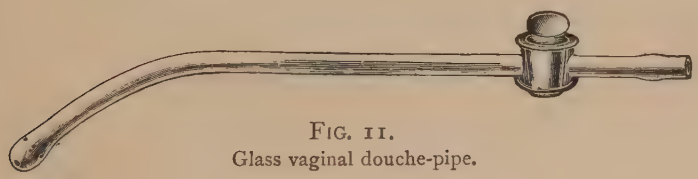


FIG. 11.
Glass vaginal douche-pipe.

FIG. 12.
Glass pipette for attaching to tube for assistant's use in vaginal operations.

CHAPTER III.

OPERATING-ROOM IN PRIVATE HOME OR HOUSE (*continued*).

STERILIZATION OF APPLIANCES AND DRESSINGS.—In any aseptic operation the following articles

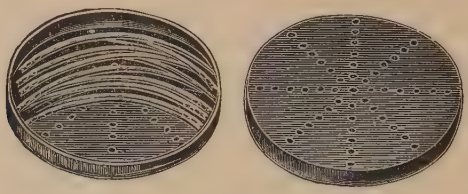


FIG. 13.
Nickel box for sterilizing needles.

have to be sterilized : instruments, compresses, tampon

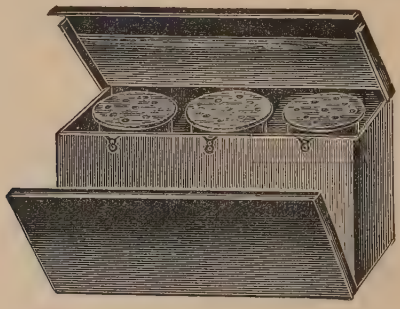


FIG. 14.
Sterilizer with reels for silk.

sponges, gauze, ligature silk, silver wire, drains, and drainage-tubes.

There are a few simple facts with regard to sterilization which have to be remembered. Bacteria do not survive a temperature from 120° to 180° C., and the spores of bacteria are destroyed by lower temperatures than these when they are submitted to air which is saturated with the vapour of water, while at even lower temperatures still—say 100° C.—micro-organisms succumb if the temperature be maintained for a sufficient time, and repeated by successive sterilizations.

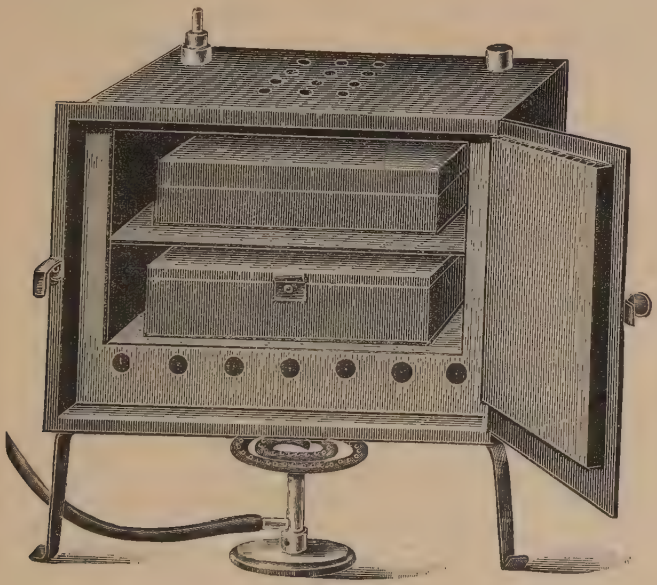


FIG. 15.
Dry stove as used by Author.

The dry stove I employ for sterilizing instruments is that of Poupinel, made by Lequeux (Maison Wiesnegg, 64, Rue Gay-lussac, Paris); it is a small model of that used by Doyen. It contains copper or nickel boxes for the instruments, which are also air-tight. The temperature in this stove rises from 150° to 160°, and the sterilization lasts for

one hour. I use Chamberland's *autoclave*, or vapour-stove, for the sterilization of the dressings, compresses, and sponges, etc.[1] In this stove can be placed two air-tight nickel bottles or boxes containing the various articles to be sterilized. Such are portable, and can be carried by the

FIG. 16.
Nickel box for placing in the vapour sterilizer.

surgeon in going any distance to an operation. The dressings, previously moistened with water, not too tightly pressed in the nickel box, are subjected to a temperature of 140°. The dressings after sterilization are moist, to which there is no objection. One hundred and twenty degrees of heat is sufficient for the sterilization of the silk ligatures, as a greater degree of heat is apt to injure them. The silk may be rolled on glass or nickel reels, wrapped in gauze, and placed, moistened with water, in a nickel bottle. *Such silk serves only for one operation.*

Sterilization of Gut.—For the sterilization of catgut[2]

[1] The pads used instead of sponges are made of absorbent wool enclosed in gauze. Dabs are cut in squares from butter muslin; thicker squares of the same or of fine *toile* are used for protecting the skin, the edges of the wound, and the intestines.

[2] Thoroughly reliable gut of every size, as used by Profs. Bergmann, Olshausen, and Martin, may be had (with full instructions for its sterilization) of M. Bôhme, 54, Orienburger Str., Berlin. Glass reels, and all the necessary appliances for silk and gut sterilization, can be had of these makers.

the method I have adopted is that employed by Frau Horn in Dr. A. Martin's klinik. The catgut is laid on flat glass plates and placed for six hours in a $\frac{1}{1000}$ solution of

FIG. 17.

Vapour sterilizer as used by Author.

corrosive sublimate (without alcohol), so that the catgut is well covered by the solution. It is then taken out and placed for twelve hours in a solution composed of two parts of the best alcohol and one part of oil of juniper. It is then transferred to some of the same solution, but *newly prepared*, and kept in this till required; but it must so remain at least fourteen days before it can be used. Should any fatty matter appear on the top, it must be carefully removed with a spoon. I transfer the gut to absolute

alcohol, and allow it to remain for six weeks in this, changing occasionally before using it.

FIG. 18.
Glass reel to keep gut in solution.

Silk.—The following is the method of sterilizing silk employed by Dr. W. S. Halsted, of the John Hopkins'

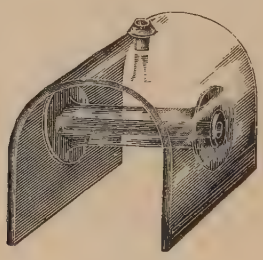


FIG. 19.
Glass reel for silk.

Hospital: The skeins of silk are opened and cut in lengths of 40 centimeters (16 inches) for carriers, and 24 to 30 centimeters (9 to 12 inches) for ligatures and sutures. Ten of these are wound on a glass reel, and several such reels of one size, or of assorted sizes, are dropped into a stout glass ignition-tube devised for this purpose. Several of these tubes, plugged loosely with cotton, are put into a steam sterilizer for an hour the first day, and on the two following days for half an hour each time. The steam passes through the cotton without

restraint, and acts upon the silk as easily as if it lay loose in the sterilizer. On removing the tubes the cotton in the

FIG. 20.

Glass needle-case for keeping sterilized needles.

mouth is pushed tightly in, and they are stored away in glass jars until wanted. Silk which remains over after an operation may be resterilized in the same way, but it is apt to be weakened after the second sterilization.

If it is necessary to take but one reel of silk out of a tube, it may be done without contaminating the rest by carefully removing the cotton stopper between the third and fourth fingers, taking care that the surface of the cotton which comes in contact with the tube does not touch anything else, while holding the tube obliquely to facilitate removing the reel with a pair of sterilized forceps.

Bergmann, of Berlin, places the catgut in 1 per cent. sublimate solution and 80 per cent. of alcohol. It is left for at least 48 hours. This immersion is renewed in fresh solution every few days until the fluid is quite clear; then the gut is kept in ordinary alcohol.

Hofmeister, of Tübingen, proceeds as follows: The raw catgut is wound without any preparation on strong glass plates or reels, so that each thread lies next to the other. The thread must be carefully and tightly wound, and

the ends are best knotted. The rolled-up catgut is then placed—

1. For 12 to 48 hours in a 2 to 4 per cent. formalin solution.

2. In running water for 12 hours, to get rid of the superfluous formalin.

3. It is boiled in water for 10 to 20 minutes.

4. It is hardened and kept in a mixture of absolute alcohol, with 5 per cent. of glycerine, and either 4 per cent. carbolic acid or 1 per cent. corrosive sublimate.

These are Howard Kelly's directions for the preparation of silkworm gut, and sponges, and iodoform gauze.[1]

Silkworm Gut.—To sterilize silkworm gut, a dozen pieces or more are loosely twisted together, doubled, and put into an ignition-tube or a piece of ignition glass tubing plugged at both ends, and sterilized in the same way as the silk.

Catgut.— 1. Cut the catgut into the desired lengths, and wind 12 strands into a figure-of-eight form, so that it may be slipped into a large test-tube.

2. Bring the catgut gradually up to a temperature of 80° C., and hold at this point one hour.

3. Place the catgut in cumol, which must not be above a temperature of 100° C.; raise to 165° C., and hold at this point for one hour.

4. Pour off the cumol, and either allow the heat of the sand-bath to dry the catgut or transfer it to a hot-air oven, at a temperature of 100° C. for two hours.

5. Transfer the rings with sterile forceps to test-tubes previously sterilized as in the laboratory.

[1] "Operative Gynæcology," vol. i. Appleton & Co., New York, 1898.

Sponges.—Sponges are difficult to sterilize, and for this reason were for some time largely abandoned; but at present they are again used more freely in abdominal surgery. When suitably sterilized, no other substitute possesses the same degree of elasticity and absorptive power. But the responsibility of sterilizing sponges is so great that it must never be left to druggists or instrument-makers.

The steps in the preparation of sponges are as follows :—

"1. Lay them in a stout cloth and pound sufficiently to break up grit and lime.

"2. Rinse with warm water ten or more times until it remains clear.

"3. Immerse in a muriatic acid solution, 15 cubic centimetres to 1 litre (ʒ ij to o j.), for twenty-four hours.

"4. Immerse in saturated warm permanganate of potash solution.

"5. Decolorize in a hot saturated oxalic acid solution.

"6. Pass through lime-water to take out all the oxalic acid.

"7. Rinse thoroughly in plain sterilized water.

"8. Immerse in a 1 in 1000 solution of bichloride of mercury for twenty-four hours.

"9. Preserve, until used, in a 3 per cent. carbolic acid solution."

"The hands manipulating the sponges during these preparations, from step 4 on, must be sterile, and much of the manipulation may be done with instruments.

"When wanted for use the sponges are lifted out with a long pair of sterilized forceps and rinsed in sterilized water. I never use the same sponge twice, although this may be safely done after aseptic operations.

"The best substitute for a sponge is Berlin wool made into a small ball and covered with gauze, which can be sterilized in the ordinary way in the steam sterilizer. Another good substitute for sponges are small gauze mops, made by cutting gauze into convenient strips and rolling them into small balls; a sufficient quantity of these sponges can be prepared before operation by the nurse, and stored in linen bags and sterilized by the fractional method."

"In operations in private houses, where the water-supply is questionable, the so-called dry technique, in which dry gauze and sponges are used instead of water, is decidedly safer."

"**Iodoform Gauze** is prepared (with aseptic hands) by rolling plain sterilized gauze in 3-metre (about 3-yard) lengths, and then cutting up the roll into different lengths and breadths to meet the various requirements.

"Before dividing the large roll into these smaller pieces, it is saturated with the following iodoform mixture: To 180 cubic centimetres (6 ounces) of warm water, made into a good suds with Castile soap, add 45 cubic centimetres (an ounce and a half) of powdered iodoform, and mix it well in a clean basin with a glass rod. Then immerse the roll of gauze in the liquid, and work it with the hands until the iodoform has been completely taken up into the meshes of the roll. This is now sterilized three times in the steam sterilizer."

Drainage-tubes are best treated by placing them in the sterilizer used for the dressings. When taken out they can be kept in carbolic acid solution 5 per cent. Just before use they should be washed in sterilized water and transferred to a 2 per cent. formalin solution. Glass

drainage-tubes are placed with the instruments in the dry sterilizer.

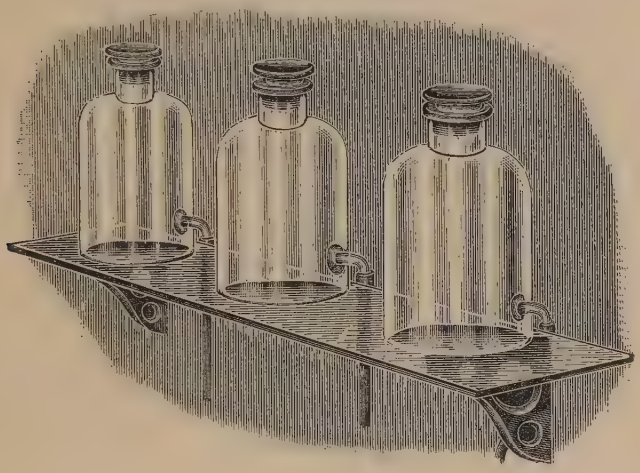


FIG. 21.

Jars on shelf for Mercuric, Formalin, and Chinosol solutions.

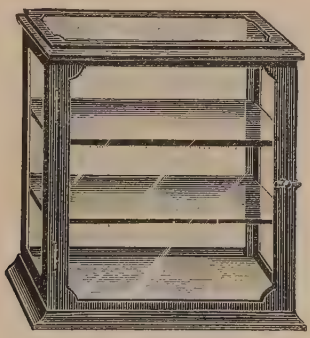


FIG. 22.

Aseptic metal and glass air-tight instrument-case.

CHAPTER IV.

PREPARATION OF SURGEON, ASSISTANTS, NURSES, AND PATIENT.

PREPARATION OF THE SURGEON AND HIS ASSISTANTS.—The requirements of ordinary cleanliness, such as frequent bathing, changes of underlinen, etc., are naturally stringently binding on the surgeon, but they are not all he has to consider. For operating he should be dressed in a clean, preferably sterilized suit, or jacket and apron, and the arms should be bare from above the elbows downwards. The same remark applies to his assistants. Nurses should wear a clean linen over-all apron, and have their arms bare. For the proper disinfection of the hands of operator, assistants, and nurses, minute precautions are necessary.

1. "Staphylococci," says Kelly, "are present on the hands of all persons."

"2. It is impossible to get rid of these organisms, even by scrubbing the hands and nails from ten to twenty-five minutes with a sterilized brush, soap, and water at a temperature of 40° C.

"3. The bichloride of mercury solutions as used, up to 1 in 500, are not so germicidal as supposed, but they are inhibitory, as demonstrated by cultures growing after the precipitation of the bichloride with ammonium sulphide" (Geppert).

As to the surgeon's, assistants' and nurses' arms and hands,

PLATE II.

SURGEON WITH OVERALLS AND JACKET. [*To face p.* 30.

PLATE III.

ASSISTANT READY FOR OPERATION. [*To face page* 33.

it may be safely said that it takes *at the very least ten minutes' time* to prepare these. Preferably, they should be washed (*from above the elbows down*) under a tap of running water, and with antiseptic soap. The nail-brushes should be kept always in antiseptic fluid in air-tight glass boxes (which are now easily obtainable), or, as I prefer, in glass boxes, to the covers of which they are screwed, being thus constantly soaked in the antiseptic. The glass cover thus forms the back of the brush. The arms should be several times well soaped as well as the hands, the nails closely pared, subjected to repeated cleansings, and the arms and hands both finally washed over with 1 in 1000 sublimate solution. *Then the hands and wrists are pressed down and kept for a few minutes in a basin of equal parts of a sublimate solution, 1 in 1000, and absolute alcohol, which solution is also carried over the arms.* The hands of the operator, his immediate assistant, the overseer of the instruments and ligatures, or those of any nurse who may have to handle instruments, sponges, or dressings, should be prepared with equal care. There should also be, at the side of the operator, a small washstand, or preferably a movable *lavabo* on castors, which has two jars provided with taps, containing sterilized water, in which his hands can be rinsed from time to time during the operation.

Some surgeons prefer the permanganate of potash and oxalic-acid method of disinfecting the hands. The efficacy of the method was tested by Drs. Ghriskey and Robb at the John Hopkins' Hospital.

"At the time these experiments were conducted," says Howard Kelly, "it was believed that the permanganate of potassium was the active germicidal agent, the oxalic acid being used simply to neutralize and decolorize the permanganate of potassium.

"A series of experiments by Dr. Mary Sherwood, conducted in 1893, at my request, to determine the relative part played by these two chemicals in the process of disinfection, however, led to the conclusion that both the permanganate of potassium and oxalic acid were germicides, but that the oxalic acid, at a temperature of about 40° C., is a much more powerful germicide than permanganate of potassium. (See John Hopkins' Hospital Reports, vol. iii. p. 359.)

"The strong evidence furnished by these two series of experiments as to the efficacy of the permanganate and oxalic acid as disinfectants is further sustained by an extended practical experience."

In Howard Kelly's clinic the cleansing and disinfection of the hands and forearms is accomplished in four steps:—

1. The hands and forearms are first vigorously scrubbed for ten minutes with a brush, using common brown kitchen soap, or green soap and hot water. Particular attention must be given to scrubbing the surfaces between the fingers, and to the nails, which must not be more than a millimetre in length. The most vigorous efforts in washing must be devoted to the spaces beneath and about the nails. The water should be as warm as can be comfortably borne, and either constantly changed with fresh water running in, or poured out and changed completely four or five times. The duration of this important step must not be measured by guessing; a clock must stand directly over the wash-basins, and assistants and nurses for the first three months should be required to spend never less than ten minutes in cleansing their hands. After the experience in washing thus gained, the time may be reduced to five minutes. Although the hands and arms appear clean, they are not aseptic, for cultures taken from beneath the nails

Should be boiled each day. Soiled dressings should be burned as soon as removed from the wound. Wash hands in a solution of carbolic acid. In case the hands have recently touched any thing foul, they should be washed in this solution for a minute or more before the dressing begins. This will deodorize & remove any oily or greasy substance

PLATE IV.

NURSE READY FOR OPERATION. [*To face p.* 34.

PLATE V.

SURGEON WITH OVERALLS AND WATERPROOF APRON PREPARED FOR OPERATION.

[*To face p.* 37.

and from the skin will develop colonies of micrococci, often in large number, in spite of any washing, however prolonged and thorough.

2. The hands, thus mechanically cleaned and softened, are next immersed in a hot saturated solution of permanganate of potash until stained a deep mahogany colour.

3. They are then immersed at once in a saturated solution of oxalic acid, which decolorizes and completely sterilizes them. The oxalic acid solution should be as warm as can conveniently be borne.

4. The oxalic acid may be removed by rinsing the hands in warm water, but it is better for this purpose to keep a dish of sterilized lime-water on hand, which at once precipitates the oxalate of lime.

After such a thorough preliminary disinfection it will be necessary to return to the wash-basins frequently during the preparations and during the operation to remove the contamination of various necessary contacts with substances not sterilized, such as the body of the patient, the outer surfaces of dishes, lids, etc.

By turning again to the wash-basins and vigorously scrubbing for ten or fifteen seconds with a fresh brush, the danger of contamination is removed.

Pads of sterilized gauze 15 centimetres (6 inches) square are useful in enabling assistants and nurses to touch handles and lids of jars, etc., without contamination.

With the completion of these antiseptic preparations the operator and his assistants are in a position to go on with their work dominated by a different impulse; for the efficient employment of antisepsis before the operation has secured a condition of asepsis which it will henceforth be the constant effort of the surgeon, assistants, and nurses to maintain throughout and after the operation.

PREPARATION OF THE PATIENT.—This should be entrusted to an experienced and careful nurse, and consists of previous bathing of the patient, free washing of her body with soap, thorough scrubbing of the part to be operated upon, and covering it with dressings wet with an antiseptic solution. In *vaginal operations,* previous antiseptic douchings of the vagina, followed by the insertion of antiseptic tampons, are the principal means to be employed. Wherever it is possible, these steps should be carried out in a separate room, and in it the patient should be carefully shaved *before* being brought into the operating-room. This shaving of the patient should be thoroughly done, and after the part has been denuded of hair it should be covered by a good lather of soap, and washed by the antiseptic. We cannot hope to carry out asepsis in vaginal operations thoroughly, and therefore they do not come within the scope of the aseptic method; but we may insist that when the patient is placed in the position necessary for, say, vaginal hysterectomy, and the external parts have been thoroughly shaved, washed, and cleansed, the last step should be sterilization of the vagina, and this can be best achieved by opening the vulvar orifice well with two fingers depressing the perinæum, while we thoroughly and repeatedly douche out the vagina with an antiseptic fluid. I now frequently adopt A. Martin's plan of douching out the vagina, when this has been well opened by fingers or retractors, with sterilized water from a pint champagne bottle, two of which are kept ready filled for the purpose. A nurse or assistant can do this from time to time during an operation as required. As little of the surface of the body as is possible should be exposed for the performance of an operation. All the surrounding parts should be covered with flat compresses which have been antiseptically

PLATE VI.

SURGEON WITH OVERALL AND JACKET READY FOR OPERATION.

[To face p. 38.

PLATE VII.

TABLE READY FOR VAGINAL OPERATIONS, HYSTERECTOMY, COLPOTOMY, CURETTAGE, ETC. (THE WATERPROOF APRON IS SEEN TO BE LONG ENOUGH TO CARRY ANY FLUID INTO THE ZINC RESERVOIR INTO WHICH THE LEGS OF THE TABLE FIT.)

[*To face p.* 41.

prepared, or have been sterilized previously, and then wetted with sterilized water. Such sterilized cloths are not

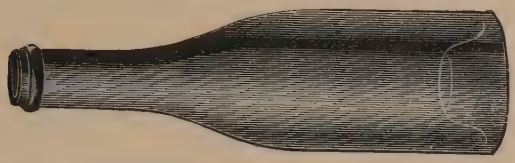


FIG. 23.

Pint bottle used for vaginal douching.

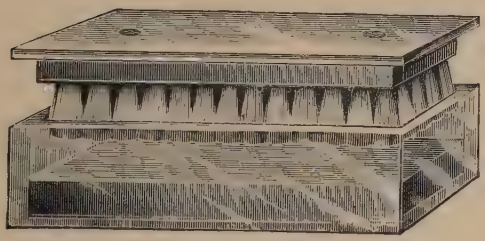


FIG. 24.

Aseptic nail-brush with box.

applied until the skin has been finally washed with a solution of equal parts of absolute alcohol and 1 in 1000 of perchloride of mercury, followed by a final rubbing of sterilized wool saturated with ether. No nurse or assistant whose hands and arms have not been prepared should take part in any of these manipulations; and if, through accident, any happen to handle or touch anything which has not been rendered aseptic, the hands should be again rinsed in the solution of alcohol and sublimate.[1]

PRECAUTIONS REGARDING NURSES.—Two nurses are placed a little behind and to the operator's right,

[1] All the waterproofs and overalls shown in the plates can be obtained of Messrs. Bohme, Berlin.

one for the immediate passing of sponges, dabs, and tampons, as well as any sterilized towels, or, if required, cloths wet with antiseptic solution. The second nurse passes to her all such fresh gauze, or other dressings, and if ordinary sponges are used, she sees to the rinsing and return of these. *Neither of these nurses should, before final sterilization of the hands and arms, touch anything in the shape of an instrument, appliance, sponge, cloth, or dressing used in the operation.* Should only two nurses be available, the nurse who places the patient on the table, and sees to the arrangement of the clothes and coverings, should finally sterilize both hands and arms before taking her place before the operation. In the room also are kept drainage-tubes, which have been sterilized in 5 per cent. phenol solutions, jars containing mercuric gut, the various dressings and other necessaries for operations ready for sterilization.

The rules I insist on for nurses are as follows :—

Rules observed by the Nurses previous to and during Operation—Antiseptic Nurse.—The nurse prepares the patient, as instructed, on the morning of the operation. She sees to the shaving, washing, and disinfection of the case, and the bringing of the patient into the operating-room. She sees to the arrangement of her clothes when on the table. She does not touch, from first to last, anything, whether instrument, sponge, compress, or dressing, which is used in the operation.

This nurse sees to the different aprons and overalls for the doctors, she shall stand by during the operation, but does *not take part in any manipulation concerned with the operation itself, or the appliances. This rule is never infringed.*

Aseptic Nurses.—Nurse No. 1 is responsible for the previous sterilization of everything which is used, or that

may require to be used during an operation. She is careful that nothing which has not been sterilized can possibly come within reach of the operator or assistants. She takes charge of, and hands directly, all sponges or compresses to the operator or assistant, standing immediately behind him. If ordinary sponges are at any time used, she passes these directly to the second nurse for rinsing and returning. She sees to the counting of sponges and torsion forceps.

Nurse No. 2 stands near No. 1, and is ready to assist with sponges and irrigator, or anything that may be directly required in the operation itself. No nurse taking a direct part in the operation is, during its progress, to pick up anything dropped on the floor. No nurse is to take part in an operation who has any infectious wound or sore on the hand, or who suffers from cold in the head.

After the hands and nails of the two nurses assisting have been rendered thoroughly aseptic, they must not touch anything which has not been sterilized.

One nurse assists immediately after the operation in the cleansing and drying of the instruments, and all instruments used are to be thoroughly cleansed before they are placed in the bag or case.

One special nurse is responsible for the tidiness and the proper disposition of the various dressings and aseptic appliances kept in the operating-room, and for the care of the operating-table.

Catheters.—Two glass catheters should be in use in every case where the catheter is required. They should be sterilized after use, in a catheter sterilizer, and then placed in a one per cent. formalin solution. If a sterilizer be not at hand, the catheter should be thoroughly washed in a five per cent. carbolic solution, and then placed in the

formalin solution until it is required. Thus, a fresh sterilized instrument is used each time.

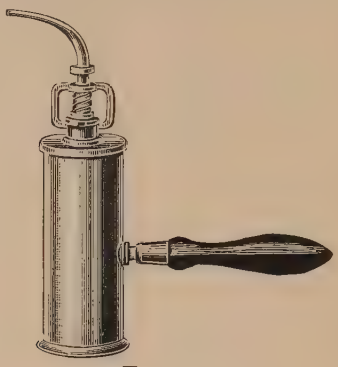


FIG. 25.
Catheter Sterilizer.

FIG. 25A.
Glass Catheter.

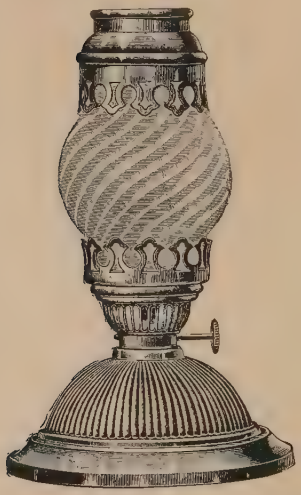


FIG. 26.

Alformant Lamp (Formalin Hygienic Co.).

Alformant "B" is made of brass and glass. It is capable of diffusing 20 to 25 tablets of Paraform, or dry Formalin, at a time. The spirit-container will hold about 8 ounces of methylated spirit, and permit nine or ten operations. The Alformant "B" is sufficiently powerful for thorough disinfection. This lamp is used for the final disinfection of every room to be occupied by a patient, in the operating-room before operations, and for the surgeon's clothes'-closet.

CHAPTER V.

OPERATION AND TOILETTE.[1]

As little of the surface of the part to be operated upon as is possible is exposed before the first incision is made. For example, in oöphorectomy or removal of the appendix it is not necessary to bare more than a few inches, the needful space being left uncovered by placing the small aseptic cloths, taken straight from the sterilizer, around the area of the wound. Or the abdomen may be covered with a sterilized cloth wrung out of antiseptic solution, with an aperture of the necessary size cut for the proposed operation. All the compresses and gauze dressings, as well as the sponges, are in like manner taken straight from the boxes, being brought into the operating-room as they have been taken from the sterilizer, and these compresses and dressings are alone used (without any disinfectant) for hæmostasis, *tamponnement*, the exclusion of the intestines, the protection of organs and vessels. The compresses are easily caught with a catch forceps, which is thrown over the edge of the wound so as to facilitate removal. As to the substance used for ligatures, choice may vary, but as a rule I use fine silk for the peritoneum, catgut for the fascia and muscle, and silkworm gut for suturing the integument. When the operation has been concluded and hæmostasis secured, the entire wound is thoroughly

[1] See also p. 30.

cleansed with the sterilized compresses, fresh ones being used to absorb any oozing, as also to facilitate the pressure or ligature of any small vessels that may continue to give trouble. Hot sterilized water is sufficient should any irrigation or washing of the wound be necessary, and if the tampon has to be resorted to, sterilized gauze is employed. Doyen holds that the *crin de Florence* is preferable to any other form of suture for the skin, on account of its solidity and its toleration by the tissues.

In true aseptic operations drainage is seldom necessary, and can only be so when we fear bleeding or oozing within the wound, or when we wish to avoid a sero-sanguinolent collection of fluid. On the other hand, drainage becomes a necessity where we are dealing with septic conditions, and in those cases of laparotomy in which purulent fluid has been evacuated in the course of the operation, and again, in such operations as vaginal hysterectomy. Take a classical example, oöphoro salpingo-pan-hysterectomy for double pyosalpinx with adhesions. Here, after completely clearing the pelvic basin and thoroughly cleansing and drying it, sterilized gauze, or sterilized iodoform gauze, is passed through the vaginal opening into the vagina, which is then shut off from the pelvic cavity by sutures, and a stout rubber tube is carried through the abdominal wound, its other end being left in the pouch of Douglas.

When an operation has been thus completed, no one in its entire conduct whose hands have not been prepared aseptically having touched anything used during its performance from first to last, we may look upon it as a thoroughly aseptic operation. Over the strip of sterilized gauze which covers the wound, or, if some prefer, the iodoform gauze, the best covering is a large and thick compress of sterilized wool.

I am now using moist chinosol gauze one per cent. for vaginal dressings. It makes an admirable covering for the abdominal wound. Some layers of this chinosol wool are laid over this. The tabloids are most convenient for making the solution for douching.

One per cent. chinosol gauze is amply strong enough for the dressing of wounds. Chinosol destroys the staphylococcus aur. pyogenes in five minutes in a solution 1 in 150. Chinosol is neither volatile nor hygroscopic.[1]

SUBSEQUENT DRESSINGS.—In many cases, for some days it is unnecessary to change the dressing when all is progressing satisfactorily. When any dressing is about to be conducted, the hands, both of surgeon and nurse, should be rendered aseptic. All dressings should be in readiness and close by the patient, while the wound is exposed for as short a time as possible. The same remark applies to the removal of the skin sutures. I invariably use sterilized gauze, wet with a one to two per cent. solution of formalin, to lay over the wound immediately it is exposed, while the new dressings are being applied.

ATTENTION TO THE VULVA AND VAGINA.—The vulva should be sponged daily with a formalin of chinosol solution, and, when necessary, the vagina should be douched with the same. After curettage of the uterus—a step which I always carry out with every antiseptic precaution—when all bleeding is arrested and any application made to the interior of the uterus, the vagina is dried with aseptic pads, and some strips of iodoform or chinosol gauze are left in it. These I do not disturb until the expiration of forty-eight

[1] *Chinosol Dressings* (B. Kühn, 36, St. Mary-at-Hill, London).—Chinosol gauze, 3 per cent.; chinosol gauze, 1 per cent.; chinosol wool, 3 per cent; chinosol lint, 3 per cent.; chinosol tablets, 1 in 01 = 1 in 600.

hours, when they are removed, and, after antiseptic douching, fresh ones inserted. These are then renewed daily for the first week after operation, after which the vagina is simply douched.

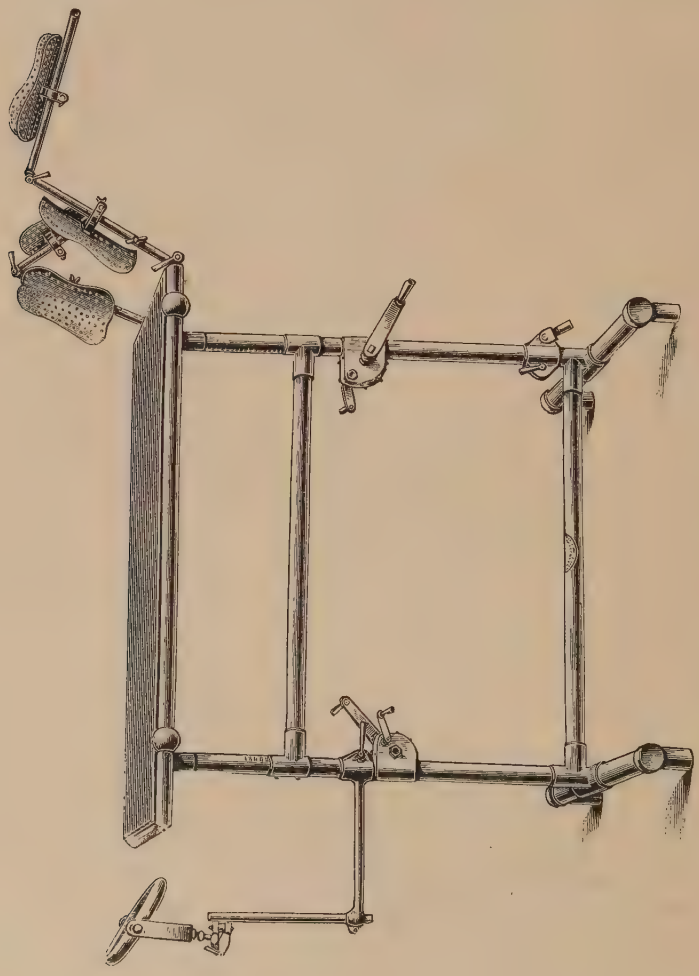


FIG. 27.
Modified table of Greig Smith with leg-rests for vaginal operations.

CHAPTER VI.

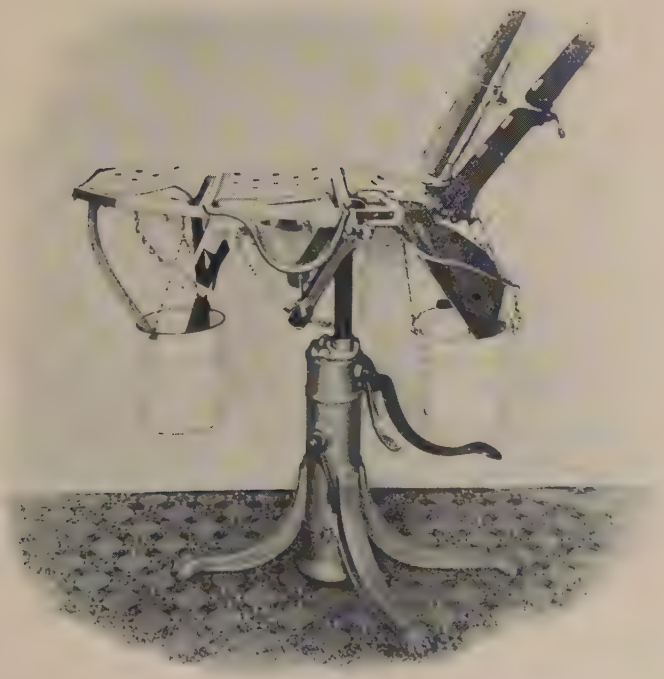
NOTES ON THE PRACTICE OF CONTEMPORARIES.

PRECAUTIONS TAKEN AT THE HÔPITAL BICHAT.—As an example of some of the precautions taken by our Paris *confrères*, a short description of the aseptic and antiseptic methods at the Hôpital Bichat under Professor Terrier may be of interest. Its surgeons insist on the importance of placing the conduct of both methods under the sole charge of a special pharmacist in the hospital. As elsewhere, a clear distinction is drawn between the indications for *antiseptics* and their use in septic wounds and operations, and those for *aseptic* precautions where we are dealing with aseptic wounds, or with those patients on whom we can operate aseptically. Professor Terrier assisted by Dr. G. Latham, formerly intern pharmacist to the Bichat, has clearly laid down the rules of practice in this hospital. The filter of Chamberland is altogether used, and through this solutions are passed previous to boiling. These are those of bichloride of mercury, carbolic acid, and boric acid, which are kept distinct from camphorated naphthol, iodoformed oil, iodoform and ether, etc. The dried powders of iodoform, salol, subnitrate of bismuth, etc., are kept in special bottles hermetically closed. It is the duty of the intern to prepare and have ready a certain number of antiseptic dressings—the tied tampons, the flat tampons for external

dressings, the gauze and wadding, which are all kept covered by cotton wool and iodoform. To prepare the materials with iodoform, a quantity of iodoform is placed in a sterilized glass in a solution of 95 per cent. of alcohol, or of equal parts of absolute alcohol and ether, with the addition of about 1 per cent. of glycerine. When soaked they are dried on iron grills previously heated. The flat tampons are powdered with more iodoform immediately after being taken out of the ether bath. The dressings remain moist, and the iodoform is very adherent. It falls to the duty of the same person to see to the keeping of the prepared sponges or tents in the bottles, the stoppers of which are protected with emery. The tarlatan compresses are kept plunged in the antiseptic solutions in large jars.

The stove used in the Bichat laboratory is a modification of the hot-air ones of Poupinel. In the hot-air stove the temperature rises from 150° to 160°, and the sterilization lasts for an hour. By the contrivance of a tube that leads from the summit of the chamber, passing through the cover and running almost to its bottom, all the water in the chamber is evacuated by pressure, and the stove is rendered dry. In a few minutes all the water has been got rid of, and the dressings are thus dried. The material in this case should not previously have been moistened with water, but simply impregnated with the vapour. There is a very large sterilizer in the laboratory of the Bichat, that combines the two objects of sterilizing the moist compresses and furnishing dry dressings. Here, also, are sterilized the different solutions employed for hypodermic or intravenous injections, which are kept ready in hermetically closed flasks. When the stove is dry the powders of boric acid, sub-nitrate of bismuth, and others, are sterilized at a heat of 150°. They are placed in glass bottles

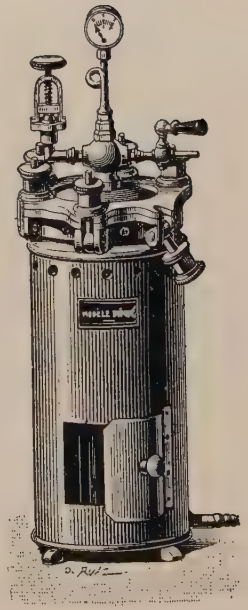
OPERATING-TABLE OF DOYEN.



DOYEN'S TABLE ARRANGED FOR VAGINAL HYSTERECTOMY.

[*To face page* 52.

MODIFICATION OF POUPINEL'S STOVE FOR BOTH INSTRUMENTS AND DRESSINGS.
Instruments to be left in for a quarter of an hour at a temperature of from 150° to 160° at the least. (*Doyen's Clinique.*)



CHAMBERLAND'S AUTOCLAVE FOR VAPOUR STERILIZATION OF DRESSINGS, COMPRESSES, ETC.

At two kilogrammes of pressure the temperature reaches 134°. The dressings are kept in for three-quarters of an hour at 120° in open nickel boxes which can be closed air-tight.

[*To face page* 55.

specially constructed with air-tight stoppers, and these are slowly cooled down in the dry stove. Catgut, dried and purified by maceration, first in a mixture of absolute alcohol and chloroform, then in a mixture of absolute alcohol, is placed in small packets in tubes closed by tampons of wadding, and is allowed to remain in the sterilizer for the space of one hour at a temperature of 125°. Such a process in no way deteriorates the catgut.

Terrier suggests as a good means of controlling the sterilizing temperature to place in each bottle of dressings a test-tube—that is, a small glass tube closed at both of its extremities, and containing some crystallized substance which by its fusion denotes when the desired temperature has been exceeded or at least reached. Thus for the compresses, tubes with *anhydride phtalique*, fusing at 129°; for silk, tubes with *benzoic acid*, fusing at 120°; and for the stoves of hot air, tubes with *salicylic acid*, fusing at 156°. These substances are coloured respectively green, violet, and red, with aniline. As a powder, the mixture is scarcely coloured, but it becomes very accentuated under the process of fusion when the mass is rendered compact. This change of colour is an assurance of the sterilization, provided that the test-tube has been placed in the centre of the bottle of compresses. At the Bichat the special laboratory, which is beneath the hospital and far removed from its wards, is partitioned into four compartments—one is reserved for the dressings intended for use on the following day. Once sterilized, these dressings are brought back to the same compartment and marked as sterilized. To this compartment alone has the nursing staff of the hospital admission. The second compartment contains the sterilizers of vapour and hot air; the third is reserved for the preparation of antiseptic dressings, and the fourth contains a stove, with

cultures for verifying the sterilization. Here, also, is a distillation apparatus for the purification of the anæsthetics used in the hospital—ether, chloroform, bromide of ethyl, the purity of which is thus secured. The steps taken in the operating theatre in regard to the preparation of the patient, the surgeons' and assistants' arms and hands, the instruments and dressings, are most rigorous at the Bichat. Nothing can exceed the care there observed.

DOYEN'S CLINIC.—Here the antiseptics almost exclusively used are phenol and the bichloride of mercury, with the fluid of Labarraque. Water is sterilized by boiling under a pressure of about 125°. The compresses and silk are sterilized by vapour at the same temperature, and the instruments by dry heat at 160°. Catgut is sterilized by dry heat by Reverdin's method, then placed in phenic alcohol at a temperature of 105°, and preserved in the same fluid. Boiling carbolized water (5 per cent.) will secure the immediate disinfection of the *crin de Florence* and instruments which have not been in the sterilizer. The operator's hands and arms are cleansed by successive washings in warm water and soap, a sublimate solution of 1 in 1000, and then a strong solution of phenol. He never employs any antiseptic powder, and for more than seven years he has absolutely forbidden any iodoform dressing, being convinced of its worthlessness. Tamponing with sterilized gauze, soaked or not with a solution of phenol, has given him far more satisfactory results than the employment of iodoform gauze. He regards diluted vinegar of Pennès as amongst the most useful of antiseptics when fœtor is present. For my own part, though I cannot say that I have altogether relinquished the use of iodoform, I am less and less

inclined to believe in its efficacy. At the Bichat, as I have said, and also in the Berlin clinics, it is still employed, both in powder and dressings.[1] I have lately been using a solution of formalin for vaginal operations, both in tampons and for dressings, when there is any fœtor in the discharge. I also use a 2 per cent. solution to dip drainage-tubes in or to cleanse any sinus with, and there can be no better immediate dressing to place over a wound than a narrow strip of sterilized gauze wrung out of the formalin solution. Chinosol I have also largely used for vaginal douchings, and have found it excellent.

Doyen's antiseptic solutions are prepared in a special apartment adjoining the operating-room. He employs for this purpose closed jars of enamelled iron containing 20 litres. Phenol in alcoholic solution is purchased in 2 kilogramme flagons, containing 1 kilogramme of absolute phenol dissolved in 1 kilogramme of alcohol (90°). Into one of these jars, purified with boiling water, the contents of a litre of this fluid is placed, and 60 grammes of powdered borax is added; then the remainder of the jar is filled with boiling water. Thus 20 litres of carbolized solution at 5 per cent. is obtained, the addition of the small quantity of borate of soda preventing the rusting of the needles and steel instruments which are not nickelled. The sublimate solution he uses is combined in its preparation with tartaric acid. This he considers renders it more stable, and gets rid of an inherent precipitate in the vessels in which it is kept. In the adjoining room leading into the operating-room are the various heating apparatus,

[1] *Iodoformogen.*—Messrs. Kuhn have introduced this preparation, which has all the advantages and properties of iodoform, but without its objectionable odour, while it is not hygroscopic, and does not cake.

sterilizers (those for vapour and hot air, the moist and dry stoves), and all the accessories necessary for the operations. I do not delay to describe the complete apparatus which is used for sterilization in the installation at the Rue d'Iena or at Rheims. Both the stoves to which I have referred are made by Monsieur Lequeux, of the Rue Gay-Lussac, 64. The vapour sterilizer serves for the sterilization of six bottles of compresses. It can also be used for the sterilization of water in sufficient quantity for the washing of hands, or for use in the course of operations, the water being heated at the same time as the cylindrical boxes of compresses. Thus the operator can take to a distance, and without any danger of infection, when summoned to an urgent case, sufficient sterilized dressings for his operation, and the nickel bottles, hermetically closed, can be heated by immersion in boiling water for a short time. In this stove are also prepared the flagons which contain from 50 to 100, or 250, grammes of artificial serum, that is, 7 of chloride of sodium in 1000 of water. The serum is sterilized at 130°, and injected subcutaneously in a dose of from 50 to 200 grammes as often as twice or three times in the day, or even oftener in grave cases. By an ingenious arrangement of tubes and bottles connected with the vapour-sterilizer, the solutions of phenol and sublimate can be brought perfectly sterilized into the operating theatre. In the dry stove the boxes of instruments, the serviettes, compresses, aprons, and wearing apparel can be sterilized, and the instruments being kept in these hermetically closed boxes, they can be taken from place to place with the sterilized dressings for use in emergency.

I refer the reader to the "Technique Chirurgicale" (Doyen, Paris: Masson et Cie., Editeurs, 120, Boulevard

PLATE X.

TABLE IN TRENDELENBERG'S POSITION SHOWING ELEVATOR FOR UTERINE MYOMATA.

[*To face p.* 56.

PLATE XI.

PATIENT ON THE TABLE IN TRENDELENBERG'S POSITION.

[*To face p.* 59.

St. Germain), for the various other aseptic appliances, such as movable washstands, injection apparatus, *porte-flacons*, as well as the most ingeniously constructed table for operation. There also will be found the description of the apparatus employed for photography and radiography. Messrs. Flicoteaux, 83, Rue de Bac, supply all these appliances and accessories. M. T. Leclerc, of 10, Rue Vignon, makes every form of sterilized compress and dressing.

PROFESSOR DR. A. MARTIN'S FRAUEN KLINIK, ELSASSER STRASSE, BERLIN.—The methods that I had the opportunity of personally witnessing in Berlin were those of Professor Olshausen, at the university Frauen Klinik, and of Drs. A. Martin and the brothers Landau at their private hospitals. I might take the first as the type of the strictest aseptic observance. In all three, vaginal operations and vaginal hysterectomy are performed in a different room to that in which laparotomy is carried out, and strict precautions are observed as regards the clothing of visitors and onlookers in the latter. Coats are removed, linen jackets and aprons are substituted, and Professor Martin uses a combination overall which covers the body from the neck to the feet. The laparotomy rooms are composed of tile, glass, and metal.

In Martin's Klinik the patient is shaved, disinfected, and placed under chloroform in an adjoining room, before being carried into the laparotomy theatre. Repeated and thorough ablution of the arms, hands, and nails, and washing of these with a solution of 1 in 1000 of perchloride of mercury, to which in the Elsasser Strasse absolute alcohol is also added, is practised. This is no mere perfunctory washing, but a thorough and prolonged

scrubbing. The abdomen of the woman is also thoroughly cleansed in a similar manner, and covered with a wet antiseptic cloth in which a circular aperture is cut. Everything used in the operation is sterilized. Only one person hands or touches the instruments and threads the needles, the sutures and ligatures being carried direct from the sterilizing fluid. Alongside the operator is placed a basin of the antiseptic fluid for occasional dipping of the hands. At Martin's and Landau's I noticed that sponges were still used, as well as the sterilized gauze, in laparotomy. At the University Klinik the sterilized gauze alone was used, both for mopping purposes and temporarily tamponing or staunching. Drainage is little resorted to. In Martin's operation for colpotomy the assistant who holds the peritoneal retractor under the pubes, or seizes the uterus with a tenaculum forceps, all through the operation directs through a pipette a stream of sterilized water on the parts, which clears them of blood and washes them clean for more easy manipulation.

From first to last in every particular and detail, the impression that remains is one of a scrupulously secured asepsis on the part of operator, assistants, nurses, surroundings, appliances, instruments, and patient.

The visitor is perhaps especially struck by the time devoted to ablutions, and by the care exercised by the assistants and nurses in not touching anything that has not been rendered aseptic, once their individual preparations are complete. All visitors to laparotomy operations are expected to take their walking coats off and put on linen overalls, with which they are provided before entering the operating theatre.

DR. HOWARD KELLY'S CLINIC.—In September, 1897, Dr. Giles visited Dr. Howard Kelly, at the John

Hopkins' Hospital, in Baltimore, and was shown by him the arrangements in his own private hospital.

The new Gynæcological Operating Theatre at the John Hopkins' Hospital, which was just being completed, fulfilled all the requirements for the consistent carrying out of the principles of antisepsis and asepsis.

"I have nowhere," he says, "seen the preparation of the operator and his assistants for abdominal operations so scrupulously carried out as in this clinic. The coat, vest, shirt, and trousers are removed in a dressing-room provided with a bath, and a sterilized linen suit put on. The jacket has short sleeves, for the upper arm only, and is buttoned up the back; the trousers have neither buttons nor buckles, but are fastened with a draw-string at the waist. Boots are changed for white canvas shoes, and the head is covered with an aseptic linen cap. Just before operation he puts on a sterilized apron, which the nurse takes from her stock.

"For the washing of the hands brushes are used which are sterilized afresh every time; and the same brush is not used by two different people. After a thorough washing and scrubbing with soap and hot water, the hands are immersed in a hot saturated solution of permanganate of potash, until stained a deep mahogany colour, after which they are immersed at once in a saturated solution of oxalic acid, as hot as can be borne. This decolorizes and completely sterilizes them. Finally, the hands are rinsed in sterilized lime-water, which precipitates the oxalate of lime.

"Visitors are required to remove their coats and to put on long linen jackets kept for the purpose.[1]

[1] This custom prevails also in several of the German clinics, such as A. Martin's, Olshausen's, Landau's, Leopold's, Sänger's, and Zweifel's.—AUTHOR.

"The assistant, after preparing his hands, may have to arrange the patient, shave and wash the abdomen, etc.; for this purpose he puts on sterilized gloves, which are removed just before the operation."

"For abdominal operations, the patient's abdomen, having been prepared, is covered with a sheet of sterilized gauze; and when everything is ready, a slit is made in the gauze over the site of the incision, and the operation proceeds.

"In the private hospital the same minute precautions are adopted as are witnessed at the John Hopkins' Hospital."

Other precautions adopted by Howard Kelly are detailed in Chapter IV.

FIG. 28.
Aseptic operating-stove.

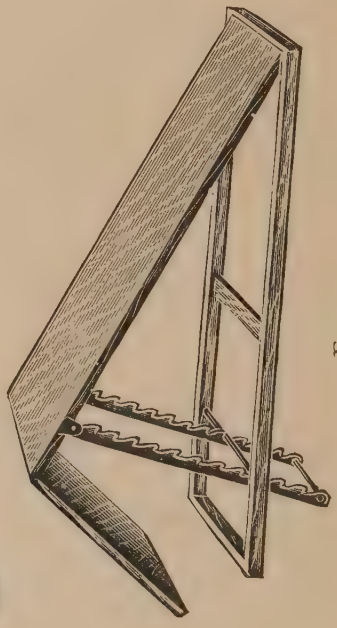


FIG. 29.
Adjustable frame for Trendelenberg's position.

ADDENDA.

Travelling-bag for Instruments and Appliances.

Contents.—Such a bag as that shown in the drawing can contain a hermetically closed nickel box with the instruments, and a nickel jar of dressings and sponges. These are taken straight from the sterilizer and placed in the bag. Sterilized wool and antiseptic dressings are

Fig. 30.

rolled up in a sterilized towel. For convenience of packing, the instruments may also be rolled in sterilized towels, as also may the sponges and dressings. Such towels are wrung out of a three per cent. solution of carbolic acid. Compresses, gauze sponges, and dressings

are, however, best left in the nickel boxes until required. This bag should also carry the sterilized nail-brush, a douche with tube and pipette, sterilized silk and gut on glass reels, rolled in sterilized layers of gauze, wet with a three per cent. carbolic solution. In it are also mercuric tabloids, sulphuric ether, two per cent. formalin solution, and a pint bottle of absolute alcohol. The surgeon's and assistant's operating-overalls and rubber aprons are laid over the appliances, and a few layers of one per cent. chinosol gauze are placed over all.

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